Early Journal Content on JSTOR, Free to Anyone in the World

This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

Read more about Early Journal Content at http://about.jstor.org/participate-jstor/individuals/early-journal-content.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact support@jstor.org.

determined. Such speculations, though they are very interesting, cannot be given any great weight. There is still a considerable region between wave length 600 and wave length *one* which must be experimentally explored.

My present limit is set by the adjustment and dimensions of my apparatus. Now that we know that a Schumann plate can be used and that a speculum grating is efficient, I see no insuperable difficulty to a still further extension by purely spectroscopic means.

---

[1] *The Spectroscopy of the Extreme Ultra-Violet*, Longmans, Greene & Co.

[2] J. J. Thomson, *Phil. Mag., London*, **28**, 620 (1914); E. R. Ladd, *Ann. Physik, Leipzig*, **46**, 605 (1915).

[3] *Berlin, Verh. D. Physik. Ges.*, **15**, 560 (1913).

UNSYMMETRICAL LINES IN TUBE-ARC AND SPARK SPECTRA AS AN EVIDENCE OF A DISPLACING ACTION IN THESE SOURCES

By Arthur S. King

MOUNT WILSON SOLAR OBSERVATORY, CARNEGIE INSTITUTION OF WASHINGTON

Presented to the Academy, April 15, 1915

The most effective laboratory means of causing a displacement of spectrum lines is pressure around the light-source, which has been found to be generally effective in changing the wave-length of lines in the spectra of the arc, spark and electric furnace. These displacements vary in magnitude for different groups of lines at the same pressure. Recently other influences have been found effective in causing small displacements, these manifesting themselves usually in making the spectrum lines unsymmetrical, usually with the red side stronger. A measurement of the maximum of the line under these conditions gives a different wave-length from that obtained for the same line when symmetrical.

We have then the two-fold problem of finding what features in the light-source produce these dissymmetries and the degree to which various lines are subject to such disturbing influences.

About two years ago, the writer described the spectrum of the 'tube-arc,' and noted that many lines were made highly unsymmetrical in this source. The tube-arc is obtained when the tube used in the electric furnace is made thin at its middle so that when the voltage is applied the tube quickly burns apart, forming an arc which carries a very large current at low voltage. This ring of arc is viewed axially and the spectrum shows many peculiarities.

Further use of the tube-arc has now been made in studying the spectrum of iron from λ 3600 to λ 6600, special regard being paid to the dissymmetries produced and the manner in which certain types of lines are intensified.

The tube-arc shows dissymmetries in a very pronounced degree which are present in a more or less incipient state in the ordinary arc, especially in the region near the negative pole. Such dissymmetries are naturally most conspicuous in the case of reversed lines, and but few of these show a fully symmetrical structure in the tube-arc spectrum, the red side usually being stronger than the violet.

The unsymmetrically reversed iron lines fall into two main groups, and these groups show a close connection with the behavior of the lines at various temperatures of the electric furnace and with their pressure displacements. The first group is made up of lines whose dissymmetry in the tube-arc is small or moderate in amount. These appear in the electric furnace at low temperature. The arc under pressure gives them approximately symmetrical and with small or moderate pressure displacements. The lines of the second group are reversed very unsymmetrically in the tube-arc, the red side being often 6 to 8 times as strong as the violet side. They are relatively much stronger in the arc than in the furnace. Under pressure they are very unsymmetrical and show large pressure displacements. In the ordinary iron arc the lines of the second group show a decided dissymmetry near the pole as compared with the center of the arc.

A similar concordance of behavior is shown for a group of strong lines in the green-yellow. These widen toward the violet near the pole of the iron arc and are displaced toward the violet by pressure. In the tube-arc these are unreversed and nearly symmetrical, but show strong displacements toward the violet. Reversal with the violet side strongest has not been observed among the iron lines, but this structure is shown by the tube-arc for the *H* and *K* lines in the calcium spectrum.

The measurement of these tube-arc lines, difficult and uncertain with a micrometer microscope, is made much more accurate by the registering micro-photometer, the curves of which show the structure of the lines and permit the interval between neighboring lines to be measured.

A number of favorably situated lines have been thus measured, the distance being taken from a line approximately symmetrical to one showing strong dissymmetry. The latter line in each case was found to be displaced by amounts ranging from 0.02 to 0.04 A. An interesting feature is that when a line is made narrow by the presence of very little iron vapor in the tube-arc, the displacement becomes very small, although stronger and wider lines on the same plate retain their one-sided character.

It has long been known that a strongly condensed spark tends to produce unsymmetrical lines in its spectrum. The writer has made a study of this effect using a powerful and very disruptive transformer spark. The dissymmetries produced are strikingly similar to those of the tube-arc. Examination of different regions of the spark showed the dissymmetry to be such as would result from the interior vapor of the spark giving a line displaced toward the red, while the outer vapor gives a symmetrical line coinciding with the usual arc line. Tube-arc lines displaced toward the violet show strong shading on that side in the condensed spark.

For the cause of these dissymmetries, which amount in each case to a displacement of the maximum of the spectrum line, it appears that we must look to an agency other than pressure. Dissymmetries in the spark have sometimes been ascribed to this, but they correspond closely to those of the tube-arc, which is operated in a partial vacuum. Also, in both sources there is no tendency for the displacement to increase in magnitude with increasing wave-length, which is a feature of the pressure effect.

A high vapor density increases the dissymmetry of tube-arc lines, but apparently cannot by itself cause such dissymmetry. Evidence on this point is supplied by the electric furnace, the spectrum lines of which are notably symmetrical with high vapor density. In the arc also, lines may be very wide when much vapor is present, and yet remain symmetrical. When the poles of the arc are approached, however, the occurrence of enhanced lines indicates a condition resembling the spark, and in this region the lines more sensitive to displacement become one-sided, an effect which is magnified in the tube-arc and in the disruptive spark.

At present these effects seem to be harmonized by considering as a necessary condition the presence of electrified particles moving at high velocities, these being given in the arc and spark by the strong potential gradients and in the tube-arc by the enormous consumption of energy by the ruptured carbon tube. If such swiftly moving electrons are present, the effect of their velocities in causing a disturbance of vibration period should be increased by the crowding together due to high vapor density. On this account the relation of the effects here described to the effect of the crowding due to pressure may be a close one, as is borne out by the similarity of the observed displacements.

A combination of electron bombardment with high pressure should give larger displacements for lines which are strengthened by strong electrical conditions. The following evidence bears this out: (*a*) The lines which are strong in the arc relatively to the furnace have large pressure displacements. (*b*) Enhanced lines as a class are found to be displaced by pressure more than arc lines. (*c*) For a given pressure the enhanced lines are displaced more in the spark than in the arc.

The details of this investigation, with corroborative evidence from other spectra, will be published in the *Astrophysical Journal.*

ON THE FACTORIZATION OF VARIOUS TYPES OF EXPRESSIONS

By Henry Blumberg

DEPARTMENT OF MATHEMATICS, UNIVERSITY OF NEBRASKA

Presented to the Academy, April 30, 1915

Not a few mathematicians have dealt with the problem of setting up criteria by means of which the irreducibility of certain expressions in certain domains may be seen at a glance from the character of the expressions. Gauss, Kronecker, Schoenemann, Eisenstein, Dedekind, Floquet, Koenigsberger, Netto, Perron, M. Bauer, and Dumas have written on the subject.[1] The work of these authors may be said to center around the Schoenemann-Eisenstein theorem, which, however, is an exceedingly special case of various theorems obtained (for example, of theorem IV when interpreted for situation 1). With the exception of Floquet and Koenigsberger, the authors mentioned deal exclusively with the case where the expressions are polynomials, and chiefly with the case of polynomials whose coefficients belong to the domain of rational numbers. Floquet and Koenigsberger have extended the investigation to the case of linear homogeneous differential expressions.

A variety of methods have been employed. Thus the theory of algebraic fields, the theory of algebraic functions, the character of the solutions of linear homogeneous differential equations, and even geometric representation (Dumas, loc. cit.) have been used. Elementary methods, requiring no such means, have succeeded in yielding only the less general results.

One of our objects is to show that elementary and comparatively short considerations may be made to yield results more general than any hitherto obtained. In fact, for a complete comprehension of the proofs, little more is required in the way of specific knowledge than an understanding of the definition of the various expressions considered